

CHILI DISEASE SYSTEM (CDS)

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ABSTRACT

Chili disease system is a web-based expert system that is developed to help staff of Jabatan Pertanian Jubli Perak identify and diagnose the disease of chili. With the useful information provided that is symptoms, and the pesticide to help prevent the diseases. Chili Disease System (CDS) help user to get the information about the disease that may attack the chili, and the symptoms. There are various types of disease of this crop that affected the product of chili. Naturally, the disease may cause by the insect pests, or maybe other symptoms. So, the changes that happened at the fruits, stem, or leaf can recognize the diseases. Current system to identify the problem was actually by doing observations regularly. The data uses are based on written document and logical thinking, but the data will probably lose if the documents are not sorted properly. By using forward chaining, the system implements a rule-based expert system technique to match and fired the fact with user input to get information about the disease of chili. This system applied rapid application development methodology for the system development process. Other than that, this application can imitate human thought and making decision almost accurate like the expert.

ABSTRAK

Sistem pengesanan penyakit cili merupakan sebuah sistem yang berasaskan web dimana ia dibangunkan untuk membantu kakitangan Jabatan Pertanian Jubli Perak bagi mengenal pasti penyakit cili yang dihadapi. Dengan sedikit bantuan melalui soalan-soalan yang di kemukakan dalam sistem ini, Penyakit Sistem Cili (CDS) ini dapat membantu pengguna mengetahui sebab-sebab serangan penyakit tersebut berlaku. Terdapat pelbagai jenis penyakit yang boleh menjejaskan produk cili ini. Contohnya, penyakit ini disebabkan oleh serangga perosak, atau mungkin gejala-gejala lain. Tidak lain juga, perubahan-perubahan yang berlaku pada buah-buahan, batang, atau daun juga dapat membantu mengenalpasti penyakit meyerang tanaman cili tersebut. Di samping itu, cara pengesanan penyakit yang sedia ada untuk mengenal pasti masalah ini adalah dengan melakukan pemerhatian yang kerap terhadap tanaman tersebut. Penggunaan data adalah berdasarkan dokumen bertulis dan pemikiran logik, tetapi data tersebut berkemungkinan akan hilang atau tidak tersusun jika dokumen tidak disimpan dengan betul. Dengan adanya teknologi yang semakin berkembang, sistem ini menggunakan teknik pangkalan sistem pakar dengan menggunakan perantaraan ke hadapan dimana peraturan teknik ini adalah dengan memadankan dan menyesuaikan fakta melalui input pengguna untuk mendapatkan maklumat yang tepat mengenai penyakit cili. Tambahan pula, sistem ini boleh meniru pemikiran manusia dan membuat keputusan yang hampir tepat seperti pakar.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Chili (*Capsicum frutescens*) is a species from a genus of flowering plants in the family of Solanaceae Family and popular in Malaysian Cuisine. This *Capsicum frutescens* can be annual or short-lived perennial plants [1].

Chili was originated from Mexico and South America but adopted to Malaysian Tropical Climate many decades ago. About 14,560 hectare of chili was grown in Malaysia annually in major producing state such as Johor, Perak and Kelantan in Commercial Scale. Chili was suitable in temperature from 20-30 Celsius with rainfall between 1,500 mm - 2,000 mm monthly and it can adapt to pH between 5.5 - 6.8 on mineral soil, peat or Bris Soil (with proper irrigation system). Red Chili or Green Chili is the product depends on harvesting period and different market needs. Study shows that Malaysian took 33,000 ton/year of fresh chili annually whereby the local production around 23,000 tan/year. Malaysia also import chili from Thailand (Cili Padi Variety) about 5,000 kg daily through Bukit Kayu Hitam Border.

Nowadays, there are million acres of red peppers are grown annually and one-quarter population of world uses it daily, primarily for culinary purpose. For some of chili farming, there are diseases that exist in this chili plants in which it

cannot know the cause and solution. A special attention must be given to these pest and disease problems. If the cause is known, the possibility of the solution is found relatively late. It becomes an inconvenience to identify what type of disease had attack this crop. The farmers need to know the disease as soon as possible so that they can handle it immediately.

1.2 Problem Statement

There is various type of disease of this crop that affected the product of Capsicum f. or chili. Naturally, the disease may cause by the insect pests, or maybe other symptoms. So, the changes that happened at the fruits, stem, or leaf can recognize the diseases.

Current system to identify the problem was actually by doing observations regularly. The data uses are based on written document and logical thinking, but the data will probably lose if the documents are not sorted properly.

By using expert system based on rule based, all the data will kept in database. This data can be update depends on the expert request. Other than that, this application can imitates human thought and making decision almost accurate like the expert.

1.3 Objectives

In this system development, the objectives are:

- i. To develop a web-based prototype application in finding the Capsicum f. diseases.
- ii. To implement the rule based expert system in the application that capable to detect diseases of Capsicum frutescens.

1.4 Project Scopes

The scope of the system development:

- i. This system is developed for Pejabat Pertanian Jubli Perak, Indera Mahkota, Kuantan Pahang.
- ii. The users of this system are the farmers and expert officers from Pejabat Pertanian Jubli Perak, Indera Mahkota, Kuantan Pahang.
- iii. This system is web-based application with rule based methodology applied.
- iv. All the data and information from department of Agriculture and farmers who own and works at chili orchard.
- v. The system is developed for identifying the type of disease based on data collected.

1.5 Thesis Organization

1.5.1 Chapter One: Introduction

Chapter One will further explain about the background of the problem, problem statement, project scope and significant. This is important to give a big representation about the project. It also elaborates on the main objectives of the project to achieve. At the end of this chapter few points is highlighted as the benefits of the project.

1.5.2 Chapter Two: Literature Review

Chapter Two will review the technique and existing similar project for use as a guidance or guidance in developing the Capsicum disease prototype. The literature review is

essential in this project as it will provide evidence and a proven conclusion to support this project.

1.5.3 Chapter Three: Methodology

Methodology used in this research will be explained in Chapter Three. This chapter will describe overall of the process in developing the project. It has eight phases in methodology within time given that need to follow.

1.5.4 Chapter Four: Implementation

Implementation describes the architecture of the system development such as the database structure and the table's design which are used SQL command to insert data into the database that has developed.

1.5.5 Chapter Five: Result and Discussion

In the Chapter Five, it discussed the result and the constraint in completing the development for the project. In this chapter also provide a comparison between these projects with the available Capsicum Disease prototype.

1.5.6 Chapter Five: Conclusions

Finally, Chapter Five divided into three main sections which are conclusion, recommendation and summary. It also briefly concludes remarks on what may be considered a successful thesis project.

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CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter, the discussion will highlight several literature reviews about the current application of expert system, and a chili or *Capsicum* disease that is related with this area.

2.1 Expert System

Expert system is a program that attempts to mimic human expertise by applying inference methods to a specific body of knowledge [2]. This body of knowledge is called the domain of Expert System(ES). The three major components of ES are: Knowledge base (KB), inference engine (IE), and user interface (UI). For better interaction with users, an ES should preferably contain an explanation subsystem component or justifier [3]. Expert systems are the most widely use commercial application coming out of artificial intelligence [4]. Artificial Intelligent is the system that converts the knowledge of an expert trough a computer by applying a software code. All programs that achieve expert-level

competence in solving problems in task areas by bringing to bear a body of knowledge about specific tasks are called knowledge-based or expert systems. Often, the term expert system is reserved for programs whose knowledge base contains the knowledge used by human experts, in contrast to knowledge gathered from textbooks or non-experts [5]. Expert systems are different from conventional computer programs because the tasks of expert systems have no algorithmic solutions and expert systems make conclusions based on not complete or uncertain information.

There are several expert system development processes [6]:

- Determining requirements
- Identifying experts
- Constructing expert system components
- Implementing results
- Maintenance and review

Expert systems can play an important role in developing area for a variety of reasons [7]:

- Expert systems are always and instantly available and always perform at the same level of expertise.
- Expert systems have direct and instantaneous access to the necessary databases and are not limited, biased, and imperfect recollection of human experts.
- Expert systems are logical, objective by emotional arguments that might influence a human expert.

- Expert systems do not forget or make mathematical errors. There are three types of expert system devised in solving real world problems. They are:
 - i. Rule-based expert system
 - ii. Model-based expert system
 - iii. Case-based reasoning

2.2.1 Rule-Based Expert System

Rule-based system is a set of "if-then" statements that uses a set of assertions, to which rules on how to act upon those assertions are created. In software development, rule-based systems can be used to create software that will provide an answer to a problem in place of a human expert. Other than that, it consists of a *rule-base* (permanent data), an *inference engine* (process), and a workspace or working memory (temporary data). Not part of the basic reasoning process, but essential to applications, is the *user interface* [8].

Rule-Based is a simple model that can be adapted to any number of problems [9]. A rule-based system has its strengths as well as weaknesses that must be considered before deciding if it is the suitable technique to use for a given problem.

Overall, rule-based systems are only feasible for problems, which any knowledge in the problem area can be written in the form of if-then rules.

2.2.2 Component of Expert System Development Team

Figure 2.1 shows the person involved in expert system development. There are five members or component in the expert system development team. There were domain expert, knowledge engineer, programmer, project manager and end-user.

The domain expert is a knowledge and skilled person capable of solving problems in a specific area or domain. This person has the greatest expertise in a given domain. An expert must be able to communicate his or her knowledge and willing to participate in the expert system development and also commit a substantial amount of time to the project [10].

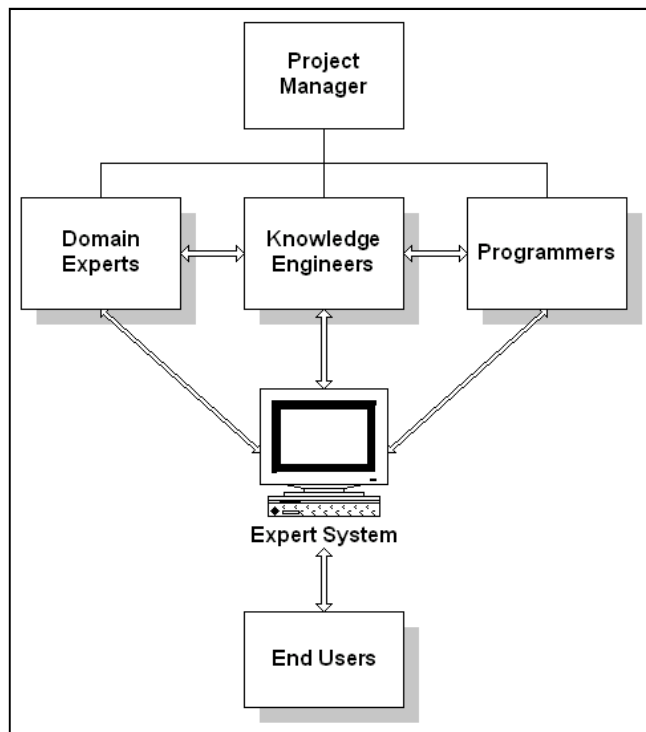


Figure 2.1: Expert System Development Team

A knowledge engineer is someone who is capable of designing, building and testing an expert system. A knowledge engineer need for selecting an appropriate task for the expert system as their responsibility. This person will interview the domain expert to gain knowledge solution on how the problem being solved. It is also known as artificial intelligence specialist responsible for the development of knowledge based application. Duties usually include knowledge elicitation, representation, and coding [11].

The programmer is responsible for actual programming describing the domain knowledge in terms that a computer can understand. This person needs some skills symbolically in programming language such as Prolog, LISP, and OPSS and also some experience in the application to be built.

The project manager is the leader of the expert system development team, responsible for keeping the project on track. He or she makes that all deliverables and milestones are met, interacts with the expert, knowledge engineer, programmer and end-user.

The end-user, often called just the user, which a person who interact or use the application of expert system after developed.

2.2.3 Structure of a Rule-based Expert System

Rule-based systems are a relatively simple model that can be adapted to any number of problems. The rule-based system itself uses a simple technique: It starts with a rule-base, which contains all of the appropriate knowledge encoded into If-Then rules, and a working memory, which may or may not initially contain any data, assertions or initially known information. The system examines all the rule conditions (IF) and determines a subset, the conflict set, of the rules whose conditions are satisfied based on the working memory. Of this conflict set,

one of those rules is triggered (fired). Which one is chosen is based on a conflict resolution strategy. When the rule is fired, any actions specified in its THEN clause are carried out. These actions can modify the working memory, the rule-base itself, or do just about anything else the system programmer decides to include. This loop of firing rules and performing actions continues until one of two conditions are met: there are no more rules whose conditions are satisfied or a rule is fired whose action specifies the program should terminate [12]. Szolovits (1988) stated that many of the early efforts to apply artificial intelligence methods to real problems, including medical reasoning, have primarily used rule-based systems. Such programs are typically easy to create, because their knowledge is catalogued in the form of "if ... then..." rules used in chains of deduction to reach a conclusion, in many relatively well-constrained domains rule based programs have begun to show skilled behavior. Rule-based system is one of the techniques that always been used for medical diagnosis. The artificial intelligence now is rapidly growth where a lot of approaches that combines with the ruled-based system such as Neural Network or Fuzzy Logic to produce a more complex diagnosis support system. There are also the upgraded versions of rule-based system such as Case-Based and Model-Based which are similar to rule-based. For example, computer-implemented Pain Management Advisor (PMA) based on an interactive knowledge-based expert system. In the abstract of the journal, Brynjestad (1999) wrote that the PMA facilitates the diagnosis and treatment of acute and chronic pain. The PMA system includes three key components: a knowledge-based component for use by the primary care providers; an inductive learning component and case-based reasoning technology for use by the chronic pain patient; and a third component used by primary care providers to consult with pain specialists and to update/modify pain management algorithms.

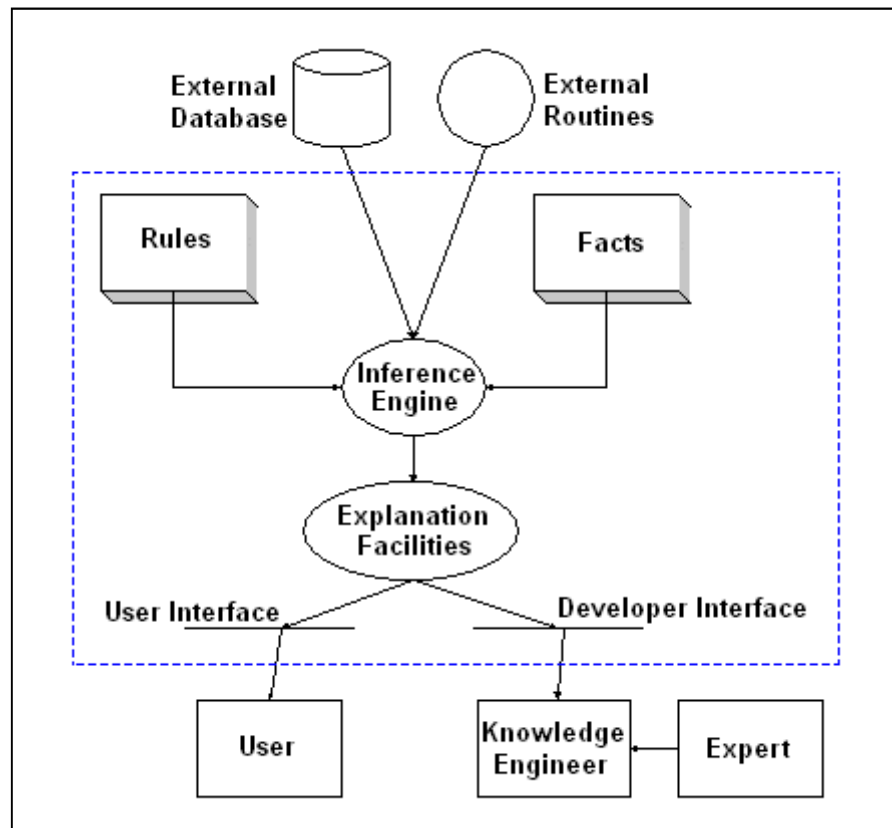


Figure 2.2: Basic Structure Rule-Based Expert System [10]

In figure 2.2, it showed the important components that make up rule-based expert system. The first component is knowledge base here it is contains domain knowledge useful for problem solving. In a rule-based expert system, the knowledge is represented as a set of rules. Each if-then rule specifies a relation, recommendation, irective, strategy or heuristic. When condition (if) part of a rule is satisfied, rule is said to fire and the action part is executed. The second component is database includes a set of facts used to match against the IF condition) parts of rules stored in the knowledge, base. The next component is

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inference engine that can carries out reasoning to reach a solution. It links rules in knowledge base with facts in database. There are two types of inference method which are forward chaining and backward chaining. The fourth component is explanation facilities. The explanation facilities showed how a particular conclusion is reached and why a specific fact is needed. The last component is user interface where the communication between a user seeking a solution to problem and an expert system. According to [12], to create a rule-based system for a given problem, you must have (or create) the following:

- i. A set of facts to represent the initial working memory. This should be anything relevant to the beginning state of the system,
- ii. A set of rules. This should encompass any and all actions that should be taken within the scope of a problem, but nothing irrelevant. The number of rules in the system can affect its performance, so you don't want any that aren't needed.
- iii. A condition that determines that a solution has been found or that none exists. This is necessary to terminate some rule-based systems that find themselves in infinite loops otherwise

2.2.4 Forward Chaining

Rule-based systems, as defined above, are adaptable to a variety of problems. In some problems, information is provided with the rules and the AI follows them to see where they lead. An example of this is a medical diagnosis in which the problem is to diagnose the underlying disease based on a set of symptoms (the working memory). A problem of this nature is solved using a forward-chaining, data-driven, system that compares data in the working memory against the conditions (IF parts) of the rules and determines which rules to fire [12].

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